3 MATERIALS AND METHODS

3.1 Overview

This chapter discussed on the pelletization experiment for three different ratios of EFB with starch and torrefaction process for constant torrefaction temperature on EFB pellets. The sample preparation techniques, pelletization process and torrefaction process experimental setup and procedures were developed to complete the experiments. The torrefied products were then subjected to calorimetric test and Fourier Transform Infrared Spectrometry (FTIR),as to calculate their mass yield, energy yield and calorific ratio.

3.2 Raw material

Oil palm empty fruit bunch will be used in this study. The raw material EFB is taken from Lepar Hilir Palm Oil Factory. The EFB will be shredded for pelletization and then undergo torrefaction process.

Figure 3-1: Obtain Raw Material from Lepar Hilir Oil Palm Factory.

3.3 Gases

The process is run under an inert atmosphere; nitrogen gas is supplied continuously during the torrefaction process. Only the flow rate of 0.5L/min of nitrogen gas is supplied during the reaction because the reactor is small.

3.4 Pre-treatment of EFB

The EFB which may contain impurities and it is in oily condition is being washed. The EFB is being sun-dry or wind dry for a few days to remove the moisture in EFB. If the moisture content in EFB is too high, it is unable to produce quality pellets with high density, solid, even and glossy surface. However, if the moisture content of EFB is too low, it is unable to produce quality pellet with well-bonded, solid and high density (Joseph, 2013). Then, the washed EFB is grinded into small size which its length is about 3mm or shorter. After that, sorting process is carried out to remove the impurities from the raw material. Finally, the EFB is being pulverized to improve the quality of the pellet and prior to pelletization process (Rahman *et. al*, 2013).

Figure 3-2: Sun Dry Washed EFB.

3.5 *Pelletization Process*

During pelletization, EFB and the starch is blended mix with four different ratios which are 100 wt% EFB+ no starch, 95 wt% EFB + 5 wt% starch, 90 wt% EFB+ 10 wt% starch and 85 wt% EFB+ 15 wt% starch. Then, the blended raw mix is inserted and pre-compressed manually into the mould. The pre-compressed particles in mould are then compressed at temperature of 120℃ and pressure of 5Mpa by using hot press machine for about 10 minutes.

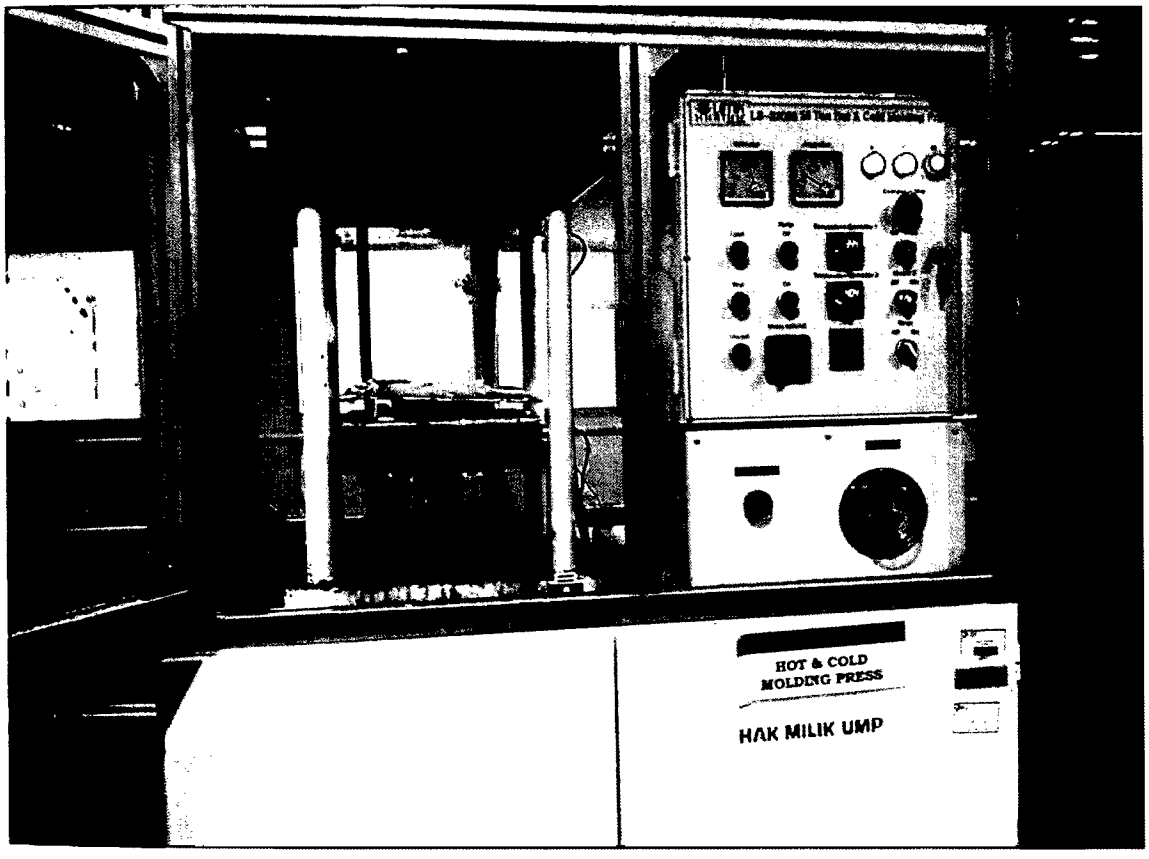

Figure 3-3: Hot Press Machine.

After the compression process completed, the densified EFB is removed and left to cool to room temperature. The densified EFB will undergo torrefaction process to further increase the quality of the densified EFB as biofuel (Rahman *et. al*, 2013). The torrefied densified EFB will undergo characterization.

3.6 *Torrefaction process*

Torrefaction of the densified EFB is carried out using a vertical tubular type reactor made of stainless steel. 2grams of densified EFB is weighted and put into the reactor.